

ALARA Procedure

This procedure establishes Ames Laboratory program and commitment to keep all exposures to ionizing radiation **As Low As Reasonably Achievable (ALARA)**. This procedure in part is the implementation of the Radiation Protection Program (RPP) functional element, ALARA program, the regulatory provisions of which are detailed in 10 CFR 835 Subpart B and Subpart K.

1.0 APPROVAL RECORD

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- Approved by: ESH&A Manager (Tom Wessels)
- Approved by: Deputy Director (Tom Lograsso)

The official approval record for this document is maintained in the Training, Documents & Records Office, 151 TASf.

2.0 REVISION/REVIEW INFORMATION

The revision description for this document is available from and maintained by the author.

3.0 Purpose and Scope

3.1 Purpose

These procedures provide the methodology for establishing and operating the Ames Laboratory “as low as reasonably achievable” (ALARA) program that will comply with U.S. Department of Energy (DOE) requirements, specified in Title 10 of the Code of Federal Regulations (CFR), Part 835, Occupational Radiation Protection; hereinafter referred to as 10 CFR 835. These procedures amplify the regulatory requirements of 10 CFR 835, the requirements of Ames Laboratory’s ALARA policy ([Policy 10202.001](#)), the ALARA Committee, and the *ALARA Committee Charter* ([Charter 10202.001](#)). In addition, these procedures define Ames Laboratory program elements to be used in conducting the ALARA program effectively, and the duties and responsibilities of each program element.

3.2 Scope

These procedures apply to all activities at Ames Laboratory in which sealed and unsealed sources of radioactive materials or machine-produced sources of ionizing radiation are used, which pose the threat of radiation exposure to Ames Laboratory occupationally exposed employees, visitors, the public or the environment. These procedures address two basic principles, which apply to every individual that may be exposed to radiation: (1) all radiation doses are to be kept ALARA, and (2) no dose to an individual shall be allowed to exceed the appropriate individual dose limit established by the regulations.

The ALARA principle is applicable even when the potential dose is well below the individual dose limit, because it is assumed that some risk may be associated with any dose of radiation, no matter how small. ALARA also means balancing the benefits of dose reduction against social needs and economic considerations. Dose limits are intended to limit the individual's lifetime risk of stochastic effects from small chronic

exposures as well as to prevent non-stochastic effects from large doses.

For individuals who are exposed to ionizing radiation as a direct result of their employment at Ames Laboratory (i.e., occupationally exposed employees), individual dose limits are based on the philosophy that their total health risks should be no greater than the risks accepted by workers in comparable occupations or industries who are not exposed to radiation. For anyone who is not an occupationally exposed employee at Ames Laboratory, (i.e., non-occupationally exposed employees, the public or visitors) the individual dose limits are much smaller than those for occupationally exposed employees. These "non-occupational" limits are based on comparisons with the ordinary risks of living, rather than on risks due to employment.

4.0 Prerequisite Actions and Requirements

4.1 Definitions

Administrative control level: A numerical dose constraint established at a level below the regulatory limit to administratively control and help reduce individual and collective radiation exposure.

ALARA committee: The multi-disciplined forum that reviews and advises management on improving progress towards minimizing radiation exposure and radiological releases.

ALARA design review: A systematic review of the design and construction of equipment/facilities to ensure that ALARA considerations are evaluated, incorporated if reasonable, and documented for modifications to existing and new facilities that involve the potential for exposure to ionizing radiation.

ALARA job/experiment review: A systematic pre- and post-job review of high-dose activities to ensure that ALARA controls are planned, evaluated, implemented where reasonable, and documented.

ALARA policy statement: A written statement, signed by upper management, which documents their commitment to the ALARA principle.

ALARA program coordinator: An individual who is responsible, at a minimum, for coordinating, promoting, and documenting activities to reduce occupational doses and the spread of radioactive materials to levels that are as low as reasonably achievable.

ALARA program assessment/audit: An internal review, audit, or evaluation of the ALARA program, designed to ensure that the program effectively complies with federal and management requirements, as well as with appropriate good practices.

Dose assessment: The process of determining radiological dose and uncertainty included in the dose estimate, through the use of exposure scenarios, bioassay results, monitoring data, source term information and pathway analysis.

Optimization methodology: A documented methodology which describes how the factors affecting a protection decision, i.e., social, technical, economic, practical, and public policy, are assigned values to compare detriment and benefits.

Radiation protection program (RPP): The documented program including, but not limited to, the plans, schedules, and other measures developed and implemented to achieve and ensure continuing compliance with 10 CFR 835 and to apply the ALARA

process to occupational exposure.

Radiological control hold point: A cautionary step in a technical work document requiring the radiological control organization to perform some action or verification. The radiological control hold point requirements should be satisfactorily completed before the work is continued.

Radiological engineer: An individual who is responsible for providing technical support and assistance to supervisors, planners, schedulers, principal investigators, and design engineers to reduce occupational doses and the spread of radioactive materials.

Radiological performance goal: An administrative objective, which focuses efforts on improving radiological performance.

Radiological work permit (RWP): The permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The radiological work permit serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological conditions.

Technical work document: A term used to generically identify formally approved documents that direct work, such as procedures, work packages, or job or research plans.

4.2 Discussion

The ALARA concept is a high priority item with the DOE. Ames Laboratory will make every effort to maintain a strong and effective ALARA Program, which is consistent with the DOE policy to conduct its radiological operations in a manner that ensures the health and safety of all its occupationally exposed employees, contractors, and the general public.

In accordance with the requirements of 10 CFR 835, formal plans and measures for maintaining occupational exposures ALARA have been developed and are part of the Ames Laboratory *Radiation Protection Program (RPP)* ([Plan 10202.004](#)).

4.3 Radiation Dose - Quantity and Units

Radiation dose limits are specified as a quantity called the effective dose equivalent in units of rems. The effective dose equivalent is the dose to the whole body from penetrating x-rays that would impart the same lifetime risk of detrimental health effects as the sum of the actual doses to all tissues and organs of the body from all types of ionizing radiation. Ames Laboratory expresses all doses and limits in millirems (1 mrem = 0.001 rem). Throughout the rest of these procedures, unless otherwise clearly specified, "dose" means "effective dose equivalent".

4.4 Individual Dose Limits

The primary occupational dose limit is 5,000 millirems per year, effective dose equivalent. The dose limit for members of the general public, including all persons who are not classified as radiation users, is 100 millirems per year. No person shall be classified as a radiation user simply to justify a higher dose limit.

The unborn child may be more susceptible to radiation effects than an adult and is, therefore, subject to a lower dose limit. The dose limit for the unborn child is 500 millirems during the entire gestation period. As a further precaution, it is advisable to keep the monthly doses below 50 millirems. This degree of protection for the unborn child can only be achieved with the cooperation of the employee, who should notify her supervisor as soon as the pregnancy is known. The limit is enforceable only if the pregnant employee gives written notice to her supervisor, who shall also notify the RSO.

4.5 Administrative Control Dose Level

Based on historical personnel radiation dosimetry records, current activities, and projected activities involving sources of ionizing radiation at AL, an annual administrative control level of 0.5 rems has been established. Although it is highly unlikely that Ames Laboratory personnel will ever have to have a "planned special exposure", this will be planned for and documented in the RPP.

5.0 ALARA Procedures

5.1 Discussion

Ames Laboratory is committed to an effective radiation protection program to eliminate unnecessary exposures to radiation and to reduce all exposures to levels that are ALARA, taking into account all social and economic considerations. The ALARA principle is an integral part of the Ames Laboratory Radiation Protection Program (RPP) and manifested in supporting policies, plans and procedures that includes specific requirements and procedures for:

- Training of all radiation users,
- Safety evaluations of proposed facilities or projects utilizing radiation in any way,
- Regular surveys of work areas for contamination and exposure rates,
- Monitoring of radiation exposures to groups and individuals,
- Investigations of all exposures that exceed predetermined levels, and
- Audits of the program by the ALARA Committee and/or other qualified experts.

Each facility or program utilizing radiation machines or radioactive materials shall be justified on its merits and shall be specifically authorized by the ALARA Committee. The review and evaluation by the Committee covers the training and experience of individuals authorized to use radiation sources, the adequacy of facilities and equipment, and procedures for the safe use of radiation sources.

Specific rules and procedures may be issued by the Radiation Safety Officer (RSO) in support of the ALARA concept as well as to assure compliance with all legal and regulatory requirements. The RSO and supporting staff provide training, consultation and other services to radiation users to assist them in controlling radiation sources and reducing exposures.

These procedures hold line management responsible for ensuring the ALARA process is fully implemented at Ames Laboratory; however, success of the program is primarily

an individual responsibility. These procedures are consistent with 10 CFR 835 and the Ames Laboratory RPP.

5.2 Roles of Key Personnel

The possession and use of radioactive materials and other sources of ionizing radiation are governed by regulations in 10 CFR 835. The DOE delegates authority to the Director of Ames Laboratory who appoints and empowers the organizations and individuals described below to develop maintain and administer an effective ALARA program for radiation protection.

Ames Laboratory permits the use of ionizing radiation sources for beneficial applications in teaching and research when such sources are acquired and used in accordance with the policies, principles and rules contained in the RPP. The protection of the health and welfare of each member of the faculty, staff, student body and general public is of primary importance; however, the financial, legal and societal obligations of Ames Laboratory and Iowa State University are also considered in the implementation of practical radiation protection practices.

Technical assessments, evaluations and interpretations shall also be consistent with the guidance and recommendations of authoritative advisory bodies, such as the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, and the American National Standards Institute.

Radiation Safety Officer:

The Radiation Safety Officer (RSO) is the individual specifically appointed by Ames Laboratory to establish and enforce policies and procedures as necessary to assure compliance with 10 CFR 835 and other applicable standards and regulations. The RSO must also ensure effective implementation of established policies and procedures. The RSO is authorized to terminate immediately any project or operation that presents a radiological threat to health or property.

Actions to restrict the acquisition of radioisotopes or the use of any radiation source, for the purpose of enforcing compliance with the RPP shall be initiated only by the RSO. The affected user may appeal the action to the ALARA Committee or to the Laboratory Deputy Director.

The RSO shall establish radiation exposure investigation levels and, if those levels are exceeded, initiate a prompt investigation of the cause of the exposure and a consideration of actions that might be taken to reduce the probability of recurrence.

The RSO is responsible for:

- maintaining copies of pertinent regulations;
- maintaining all records of the acquisition, use and disposition of radiation sources within the jurisdiction of Ames Laboratory;
- maintaining records of radiation monitoring and surveillance related to exposures of individuals from Ames Laboratory-controlled sources; and

- providing instruction and services to radiation users for the safe and authorized use of radiation.

With respect to the use of radioactive materials, the RSO is responsible for investigating spills, losses, thefts, unauthorized receipts, uses, transfers, disposals, and other deviations from approved radiation safety practice and implementing corrective actions as necessary.

The RSO reports to the Manager, ESH&A on administrative matters and to the ALARA Committee on technical matters related to the ALARA program. The RSO receives direction from the Manager, ESH&A with regard to procedure and provides technical advice to the ALARA Committee, radiation users and the administration.

ALARA Committee:

The ALARA Committee is the governing body for all aspects of radiation protection within Ames Laboratory groups utilizing radiation sources in facilities owned or controlled by Ames Laboratory. The ALARA Committee will ensure that all possession, use and disposition of radiation sources by Ames Laboratory personnel complies with requirements of 10 CFR 835 and the RPP and that all concomitant radiation exposures are maintained ALARA.

The ALARA Committee is composed of individuals who represent the various uses of radiation within Ames Laboratory and are knowledgeable and experienced in the safe use of radiation sources, as well as individuals representing various administrative and service functions. Representatives of Occupational Medicine and of Ames Laboratory management are required on the Committee. The RSO is a member of the Committee. The Committee is required to meet at least twice each calendar year.

The ALARA Committee is empowered and directed to promulgate policies, rules and procedures for the safe use of radiation sources. The ALARA Committee is responsible for assuring that only qualified individuals are permitted to use radiation sources or to supervise such use by others. The ALARA Committee oversees reviews and audits the activities of the RSO and supporting staff, and all users of Ames Laboratory radiation sources. The ALARA Committee reports to the Laboratory Director. The ALARA Committee may, at its discretion, establish subcommittees to perform specific functions on behalf of the entire committee.

The ALARA Committee reviews recommendations for maintaining the administrative dose limit, individual and collective doses ALARA. On the basis of safety, and with regard to training and experience, the ALARA Committee shall approve or disapprove any individual who is to be designated as the RSO, or who is to be authorized as a responsible user.

Each application for use of any source of ionizing radiation is first reviewed by the RSO to assure that it is complete. If the application is for possession of a generally licensed category of radioactive material, it may be approved by the RSO without review by the ALARA Committee. All other applications shall be submitted to the ALARA Committee for evaluation and approval. The RSO shall notify the applicant promptly of the action

taken by the ALARA Committee.

Amendments to existing authorizations are normally approved by the RSO if, in the judgment of the RSO, the amended use is within the intent of the initial authorization. If the requested amendment is for a completely different category of use, i.e. if it requires substantially different training, experience or facilities than those required for the initially approved use, the request shall be referred to the ALARA Committee.

On the basis of safety, and with the advice and consent of the RSO and the management representative, the Committee shall review and approve or disapprove changes in radiation safety procedures that do not conflict with any regulatory requirement and that will not decrease the existing level of protection or safety.

At each meeting, with the assistance of the RSO, the Committee shall review a summary of occupational radiation doses. The Committee is required to review the overall radiation safety program at least annually. The ALARA Committee Chair will provide a yearly letter summarizing ALARA findings and actions to the Laboratory Director on progress in meeting established goals.

Radiation Users:

A radiation user is any individual whose official duties or authorized activities include handling, operating, or working in the presence of, any type of radiation source, whether or not such use is confined to a restricted area.

A normally exposed radiation user is an individual who could receive more than one-tenth (10%) of any occupational radiation dose limit.

A potentially exposed radiation user is an individual who is unlikely to receive one-tenth (10%) of any occupational dose limit, but who works with sources that could produce a significant dose accidentally.

A minimally exposed radiation user is an individual who is unlikely to receive one-tenth (10%) of any occupational radiation dose limit. This category includes individuals who routinely handle only small quantities of radioactive materials, and others exposed only intermittently, e.g., emergency and security personnel, maintenance, packaging and transportation, custodial and housekeeping personnel.

Each user must understand and follow the general rules and procedures for working safely with radiation sources as presented in these procedures. Each radiation user shall participate in radiation safety training as specified by the RSO.

As a condition of employment, each radiation user is required to provide certain personal information to the RSO. The required information includes (1) primary identification data, e.g. full name, birth date, sex, and Ames Laboratory identification number (social security number); (2) previous training and experience with radiation sources; and (3) current employment status, including job title or description, department, supervisor, and work location.

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Personal records of radiation users also contain the scores obtained on tests taken to demonstrate knowledge of radiation safety procedures, data obtained from monitoring of external and internal radiation exposures, and reports on any injuries or abnormal incidents related to the use of radiation sources. Individual radiation user records are treated as confidential and are available only to those with a legitimate need for the information. An individual may review the contents of his or her personal radiation user file at any time, and may obtain a summary of his or her radiation history annually, or upon termination of employment, upon written request to the RSO.

Any radiation user may communicate directly, in confidence and without prejudice, with the RSO or any member of the ESH&A or the U.S. Department of Energy on any matter concerning radiation protection.

Qualified User:

A qualified user is an individual who through appropriate training and experience is qualified and authorized to work independently with radiation sources and to supervise such use by others.

Responsible User:

A responsible user is a qualified user authorized by the ALARA Committee to acquire and use specific radiation sources, and to supervise such use by others. Authorization for the use of any radiation source is conditional upon complete compliance with regulations and the procedures promulgated by Ames Laboratory's ALARA Committee. Because of the responsibilities and liabilities involved, a responsible user shall be an employee of Ames Laboratory. The responsible user is normally a principal investigator and/or faculty member who has primary scientific, financial and legal responsibility for a research program, and signature authority on at least one Ames Laboratory account.

Each proposed use of radioactive materials, x-ray or other radiation generating machines must be submitted to the Committee, via the Radiation Safety Officer (RSO), for review before implementation. The descriptions of facilities and equipment, the training and experience of the user, and the operating or handling procedures shall be provided in sufficient detail to permit the ALARA Committee to evaluate the safety of the proposed use.

To assure that all records related to radiation sources, users and conditions of use are accurate and up-to-date, the RSO may require that parts or all of the application be verified or resubmitted periodically. If the updated information includes changes that are significant to safety, the application will be submitted to the ALARA Committee for re-authorization.

An individual is approved as a responsible user only after:

- Demonstrating to the satisfaction of the RSO and the ALARA Committee that he or she has had sufficient training and experience in the safe use of radiation sources and is in a position to exercise physical and financial control of the intended radiation sources;

- Providing to the ALARA Committee a detailed plan for the proposed radiation use, including secure storage, safe handling, control of exposures and appropriate waste disposal methods and updating such information by means of periodic revisions or renewals of the authorization request as required by the Committee;
- Acknowledging and accepting in writing the responsibility for:
 - ◆ instruction in radiation protection practices for all personnel working with radiation sources and/or within facilities for which he or she is responsible;
 - ◆ acquisition of equipment, supplies and services necessary for the safe use of radiation sources;
 - ◆ security against misuse or theft of radiation sources;
 - ◆ maintaining reasonably accurate inventory records for all radionuclides, including acquisitions, uses, transfers, disposals and decay;
 - ◆ performing exposure and/or contamination surveys, and maintaining related records as appropriate to the nature of the radiation use and as specified by the RSO;
 - ◆ notification of the RSO of any accident, injury or abnormal incident related to radiation sources; and
 - ◆ arranging for authorization of another individual to assume the preceding responsibilities, or to suspend or terminate all radiation uses, prior to any extended absence.

The responsible user may use the authorized radiation sources personally or, with the approval of the ALARA Committee, may delegate the operational responsibilities to a qualified user. Each responsible user shares a responsibility with all other responsible users to serve on the ALARA Committee, if needed to provide the necessary diversity of expertise.

Environment, Safety, Health & Assurance (ESH&A):

The ESH&A Office shall provide the administrative and technical services in support of the radiation protection program. The Health Physicist is the RSO and reports to the Manager of ESH&A.

5.3 Practices and Guidelines

ALARA Goals:

ALARA goals shall be established and evaluated at least every three years. ALARA goals shall be related to specific characteristics of operations at Ames Laboratory involving the use of sources of ionizing radiation and will correspond to real problems. ALARA goals shall assure that the primary goal (ALARA) is achieved.

Status of the ALARA Program:

Health Physics personnel perform periodic reviews of the Director's ALARA goals to ensure they are being completed in a timely manner and are pertinent to current radiological activities. Ames Laboratory continually seeks ways to reduce potential

doses for given activities, so long as the cost of the consideration does not exceed the value of the potential dose, which is being saved. The ALARA Committee Chair will provide a yearly letter summarizing ALARA findings and actions to the Laboratory Director on progress in meeting established goals.

Training:

All Ames Laboratory radiological training shall be conducted in accordance with the Ames Laboratory RPP. Radiological training will use ALARA principles as a foundation and emphasize methods, which can be used by Radiological Workers to minimize exposure to sources of ionizing radiation.

Radiation Protection Program (RPP):

The RPP contains or references policies, plans and procedures for applying ALARA to occupational exposures. These policies, plans and procedures will be documented and associated ALARA records shall be maintained

Radiological Work Permits:

Ames Laboratory will fully utilize the Radiological Work Permit process, as described in the RPP. In conjunction with RWPs, a formal ALARA review will be carried out for activities that have the potential to exceed radiological trigger levels, such as: estimated individual or collective dose is greater than pre-established values; the predicted concentrations of airborne radioactivity could exceed pre-established values; removable contamination in work areas could be greater than 100 times the values in 10 CFR 835, Appendix D; entry into areas where dose rates exceeding 1 rem/hr are possible; and there is a potential for radioactive releases to the environment.

The RWP process will include pre-job planning, inspections during the work; trigger levels of exposure and post-job reviews.

5.4 Maintenance of Records

Actions taken to maintain occupational exposure ALARA, including the actions required for this purpose by 10 CFR 835.101 shall be documented.

Individuals are monitored in accordance with 10 CFR 835.402; therefore, appropriate records, as required by 10 CFR 835, are maintained to document the doses received. Quarterly monitoring results, annual reports, and other records related to the dosimetry program are maintained.

Unless otherwise specified in Subpart H of 10 CFR 835, all records will be retained until final disposition is authorized by DOE. Retention of records is performed in accordance with the requirements of the DOE records retention program and the Ames Laboratory's Documents Control Program.

6.0 Post Performance Activity

6.1 Environment, Safety, Health & Assurance (ESH&A)

ESH&A, specifically the Health Physics section, shall have the responsibility and authority to implement and maintain the ALARA program. Health Physics shall ensure the Director's goals for the program are being carried out and shall maintain all records associated with the ALARA program. Health Physics shall coordinate and assist in internal audits of the program and provide key personnel to sit on the various committees and working groups for the purpose of the ALARA program.

6.2 Internal Audits

As part of the quality assurance program, internal audits of the ALARA program shall be scheduled periodically, but no less often than every three years in accordance with 10 CFR 835.102.